June 21, 1883.

THE TREASURER in the Chair.

The Presents received were laid on the table, and thanks ordered for them.

Professor George Francis Fitzgerald, Dr. Walter Flight, Mr. John Newport Langley, and Mr. John Venn were admitted into the Society.

The following Papers were read:—

I. "On Line Spectra of Boron and Silicon." By W. N. Hartley, F.R.S.E., &c., Royal College of Science, Dublin. Communicated by Professor Stokes, Sec. R.S. Received May 28, 1883.

In the course of an extended examination of all varieties of saline solutions by means of the spark and a photographic camera, I have observed two spectra of much interest. I detach my notes from the paper in which they are embodied in order to give them an earlier publication.

Boron.—In order to ascertain whether sodium borate would yield any spectrum beyond that due to sodium, a strong solution of borax was first examined and subsequently a saturated solution of boracic acid. The graphite electrode with which the solution was submitted to the action of the spark, was opposed to a pole of a tin-cadmium alloy, in order that the wave-lengths of any lines that might appear could be determined by reference to those of tin and cadmium. It is a remarkable fact that when a saturated solution of borax is used, the sodium lines are not visible, while there appear three strong sharp lines, which as they are likewise yielded by boracic acid must be considered as characteristic of boron.

The Spectrum of Boron.

Scale numbers.		Wave-lengths.
96·18	....	3450·3
269·20	....	2497·0
269·48	....	2496·2

Silicon.—A strong solution of sodium silicate was in like manner submitted to the action of the spark. There was only a feeble indication of the strongest sodium line ($\lambda=3301$), but a strong

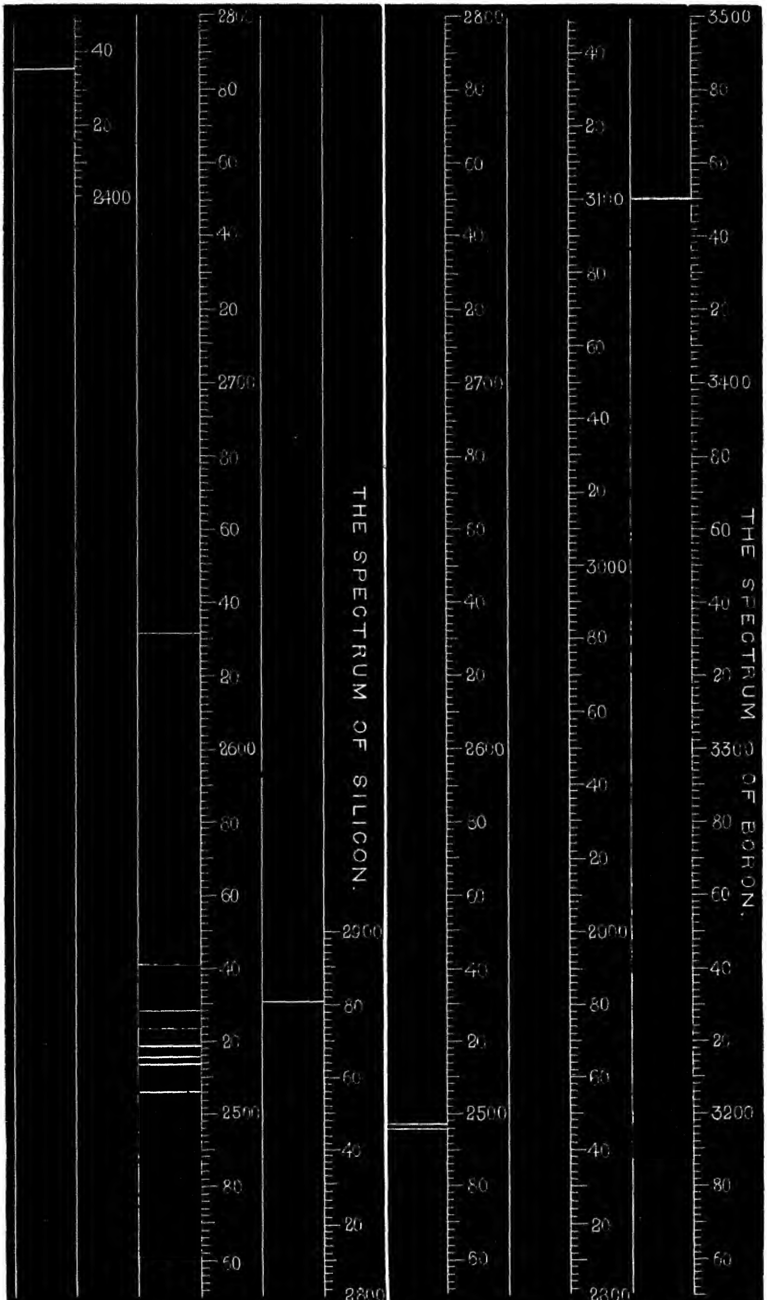
spectrum was obtained consisting of a beautiful group of lines with three isolated rays. These lines are attributed to silicon, because they are rendered equally well by sodium silicate, sodium fluosilicate, and by hydrofluosilicic acid, the electrodes being either of gold or of carbon. The strength of the lines is proportional to the strength of the hydrofluosilicic acid solution examined. The fiducial lines of the tin-cadmium alloy and some of the air lines were employed as before in obtaining measurements from which the wave-lengths of the silicon lines were calculated by means of an interpolation curve. Below are given the wave-lengths of the silicon lines, together with their scale numbers referring to their position on the prism spectrum. The scale numbers are comparable with those given in a paper recently submitted to the Royal Society, and are also applicable to my photographs of spectra in the "Journal of the Chemical Society," vol. 41, p. 90. They represent hundredths of an inch and fractions thereof, reckoned from a strong air line with wave-length 4628·9, which is numbered 10. ("Measurements of the Wave-lengths of Lines of High Refrangibility in the Spectra of Elementary Substances": Hartley and Adeney.)

The Spectrum of Silicon.

Scale numbers.		Wave-lengths.
178·98	....	2881·0
233·17	....	2631·4
256·78	....	2541·0
260·36	....	2528·1
261·65	....	2523·5
263·07	....	2518·5
263·98	....	2515·5
264·44	....	2513·7
266·54	....	2506·3
288·00	....	2435·5

These are the first spectra of boron and silicon obtained from metallic salts.

In Messrs. Liveing and Dewar's map of the carbon spectrum ("Proc. Roy. Soc.," vol. 33, p. 403), I have observed a group of lines not seen in the spectrum of graphite obtained by me ("Journal of the Chemical Society," vol. 41, p. 90), which might be accounted for by a difference in strength of the spark employed. This group, however, resembles in a striking manner the seven lines in the spectrum of silicon. (See the map of the silicon spectrum.) Their wave-lengths are the following—2541·0, 2528·2, 2523·6, 2518·7, 2515·8, 2514·0, 2506·3. It will be seen by comparison that these lines approximate so closely to those of silicon that the numbers are well


THE SPECTRUM OF SILICON.
THE SPECTRUM OF BORON.

within the experimental errors of measurement of identical lines. Professors Liveing and Dewar took the lines which they mapped from sparks passed "between poles of purified graphite in air, carbonic acid gas, hydrogen, and coal-gas. The same lines have been observed in photographs of the spark between iron, and between aluminium poles in carbonic acid gas." "The graphite was purified by being stirred in fine powder into fused potash, and subsequent treatment with *aqua regia*, by prolonged ignition in a current of chlorine, and by treatment with hydrofluoric acid." "Notwithstanding the purification the photographs of the spark between these electrodes still showed very distinctly the lines of magnesium and iron."

From these quotations it will be seen with what great care the preparations for these observations on the carbon spectrum were made. If the poles employed had been those of graphite only, I should have had little hesitation in attributing the seven lines to the silicon spectrum, but they were replaced by iron and by aluminium. Even the purest iron wire contains small traces of silicon, and aluminium of the usual commercial quality certainly contains a considerable quantity. There is, therefore, a suspicion that the carbon spectrum was contaminated by silicon, for a series of seven consecutive lines so nearly coincident with those in the spectrum of another element of the same class would be very remarkable.

II. "On the Steady Motion of a Hollow Vortex." By W. M. HICKS, M.A., Fellow of St. John's College, Cambridge. Communicated by J. W. L. GLAISHER, M.A., F.R.S. Received May 31, 1883.

(Abstract.)

The investigation to which this refers forms a continuation of some researches commenced about three years ago, but which the author was compelled by other engagements to lay aside. The general theory of the functions employed was published in the "Transactions of the Royal Society" (Part III, 1881), under the title of "Toroidal Functions." These and analogous functions are employed in the present communication.

The interest of investigations of the properties of small vortices depends on their connexion with the vortex atom theory of Sir W. Thomson, and it was this and the further connexion with a gravitation theory which induced me originally to undertake the investigation. So far as I am aware, very little has been done towards a quantitative theory of vortices beyond the paper "On the Vibrations of a Vortex Ring" by Mr. J. J. Thomson, published in the "Transactions" of this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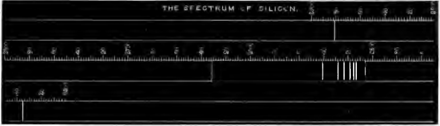
THE SPECTRUM OF SILICON.